

SUSTAINABILITY

What is it?

Do we really mean it?

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An Inconvenient Truth

A Really Inconvenient Truth

A Really Uncomfortable Truth

A Really Uncomfortable Problem

What is Sustainability?

- Maintainable at length without interruption or lose of quality. (Webster's)
- The capacity to endure. (Wikipedia)
- Maintaining a diverse and productive biosphere over time.

Tim's Suggestion The Long Version

The Principle of Sustainability

The Citizens of Earth choose to conduct their local and global affairs in a way to advance the human condition and achieve steady-state equilibrium with the planet's resources and its biosphere.

Tim's Suggestion The Short Version

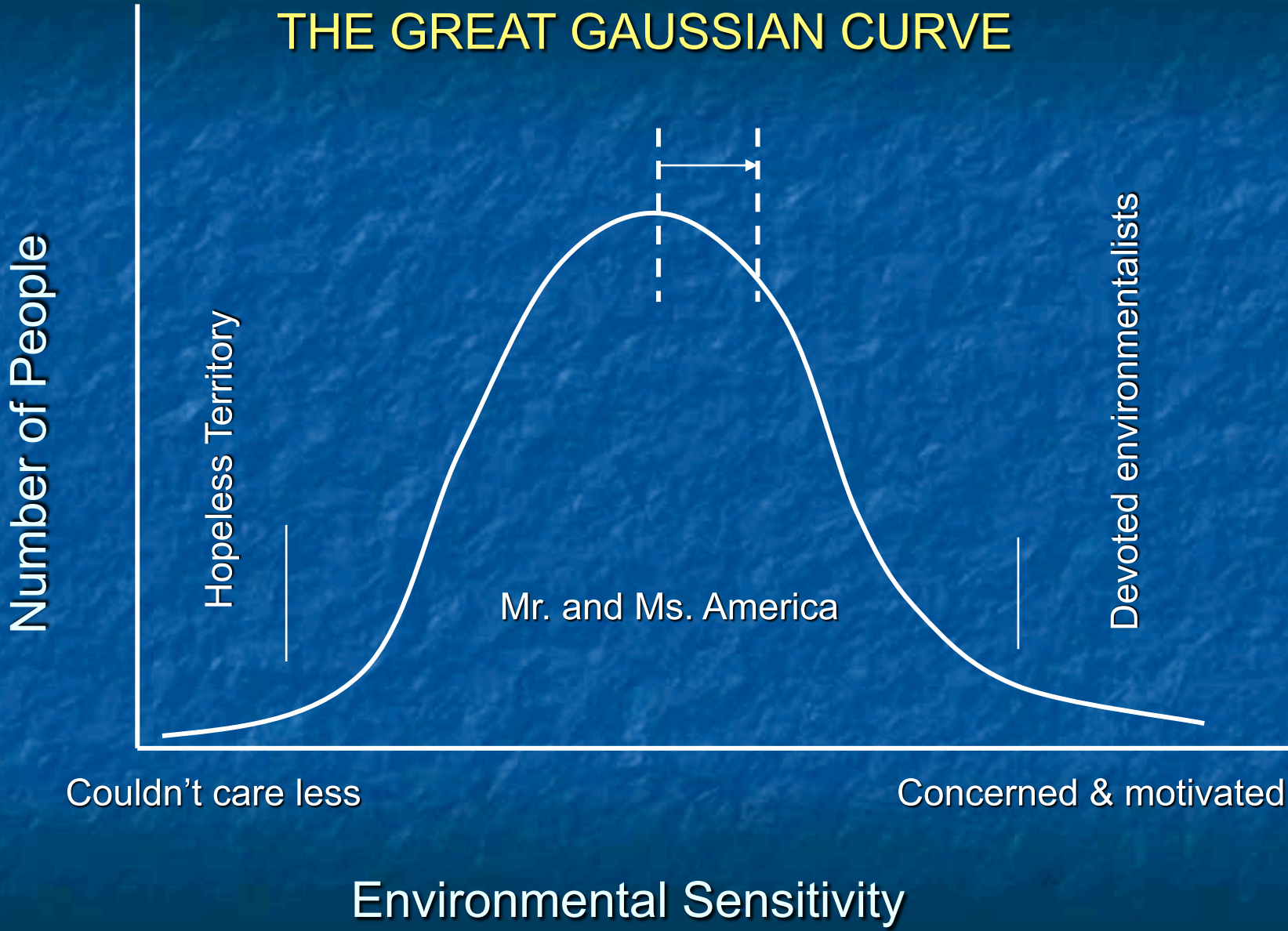
The Principle of Sustainability

Let's build a better world for the long-term.

Good Things Are Happening

- All utilities are conserving resources.
- “No coal...40% renewables by 2020” Mayor Villaraigosa, July 2009
- “33% renewables by 2020” Gov. Schwarzenegger, Sept 2009.
- New U.S. vehicle fuel standards.
- Possible cap and trade for GHG emissions.
- Public Works Building now has HEU’s.
- Carbon footprint is being considered more and more.
- New vocabulary
 - Sustainability
 - Going Green
 - Green power, bioenergy, biofuels

THE GREAT GAUSSIAN CURVE



What do Mr. & Ms. America say?

*“I’m all for sustainability....provided
the other guy does it first,
I’m not inconvenienced in any way,
it doesn’t cost me anything.”*

Has America Changed?

Yankee thrift:

“A penny saved is a penny earned.”

“Waste not, want not.”

“Save for a rainy day.”

Spend thrift:

“If it’s cheap, I can’t be bothered.”

Americans have demonstrated over and over that they won’t conserve something that is cheap.

Engineers have done a Great Job!

- Conquered water borne diseases (in the developed world).
- Potable water for everyone even in a desert.
- Sewage treatment for everyone (in the developed world).
- Electricity and natural gas anytime and anywhere.
- The Green Revolution.
- Gasoline anywhere anytime.
- Man on the moon.
- Robots on other planets.
- HDTV, computers, the internet, blackberries, I-pods.

But Engineers can't beat the 1st and 2nd Laws of Thermodynamics!

The Cacophony of Doom

Can America separate likely from unlikely?

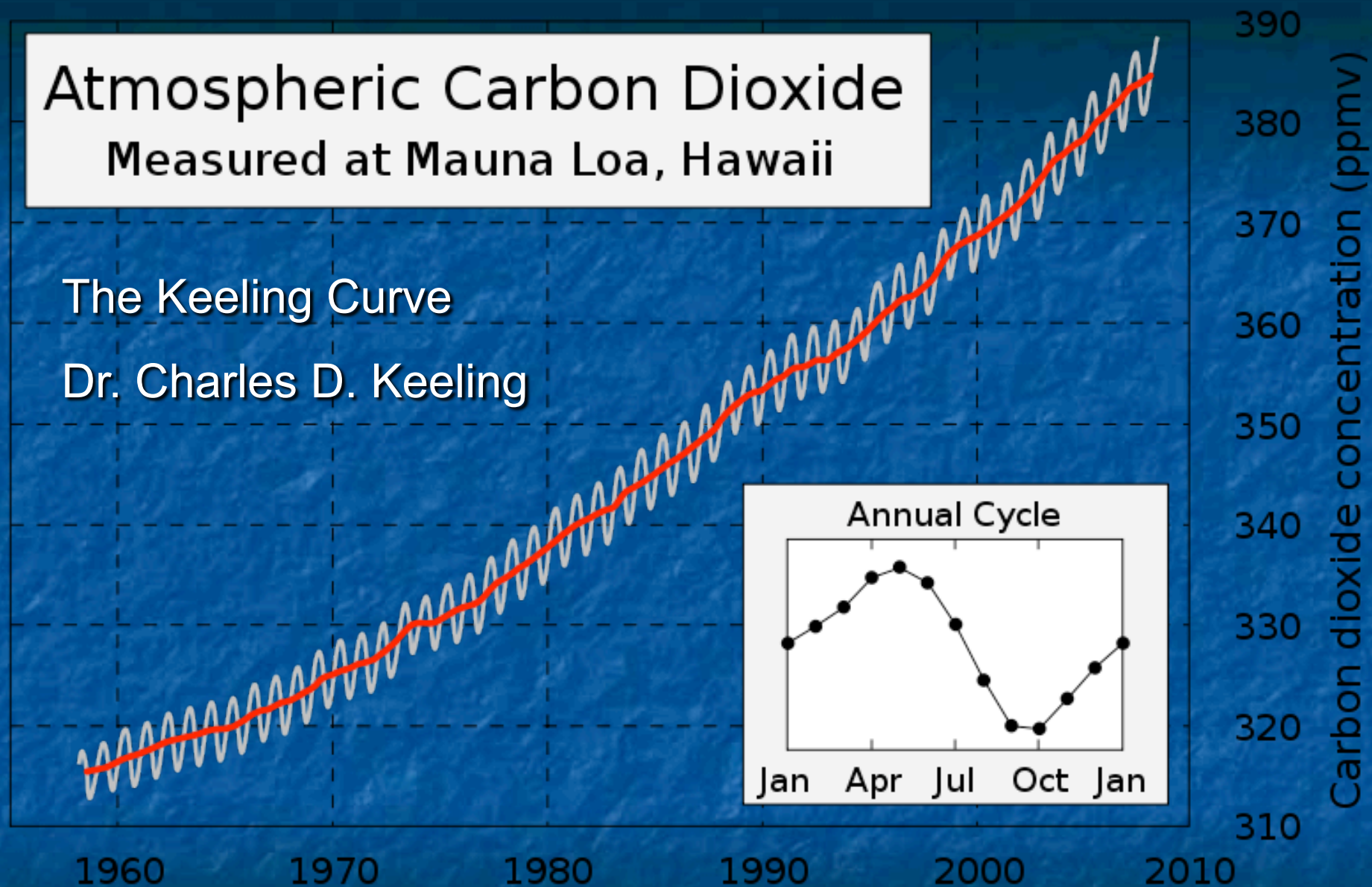
- Normal Disasters
 - Floods, fire, hurricanes, tornadoes, earthquakes, tsunamis
 - famine, drought, pestilence, volcanoes.
- Cold war, nuclear war, terrorists, regular wars, nuclear winter
- AIDS, SARS, avian flu, H1N1 swine flu, MRSA
- Hemorrhagic fevers - ebola
- Asteroids, gamma ray bursts, entropic doom
- Junk food
- Diesel fumes
- Alien abductions
- Mass extinctions

- Climate change (*"This could be serious!"*)

Atmospheric Carbon Dioxide Measured at Mauna Loa, Hawaii

The Keeling Curve

Dr. Charles D. Keeling



“..the observed rate of increase is nearly that to be expected from the combustion of fossil fuel.” C. D. Keeling (1960)

ENERGY SOLUTIONS FOR A SUSTAINABLE WORLD

SCIENTIFIC AMERICAN

**SPECIAL
ISSUE**

SEPTEMBER 2006
WWW.SCIAM.COM

\$4.99

How to Power the Economy and Still Fight Global Warming

Energy's Future Beyond Carbon

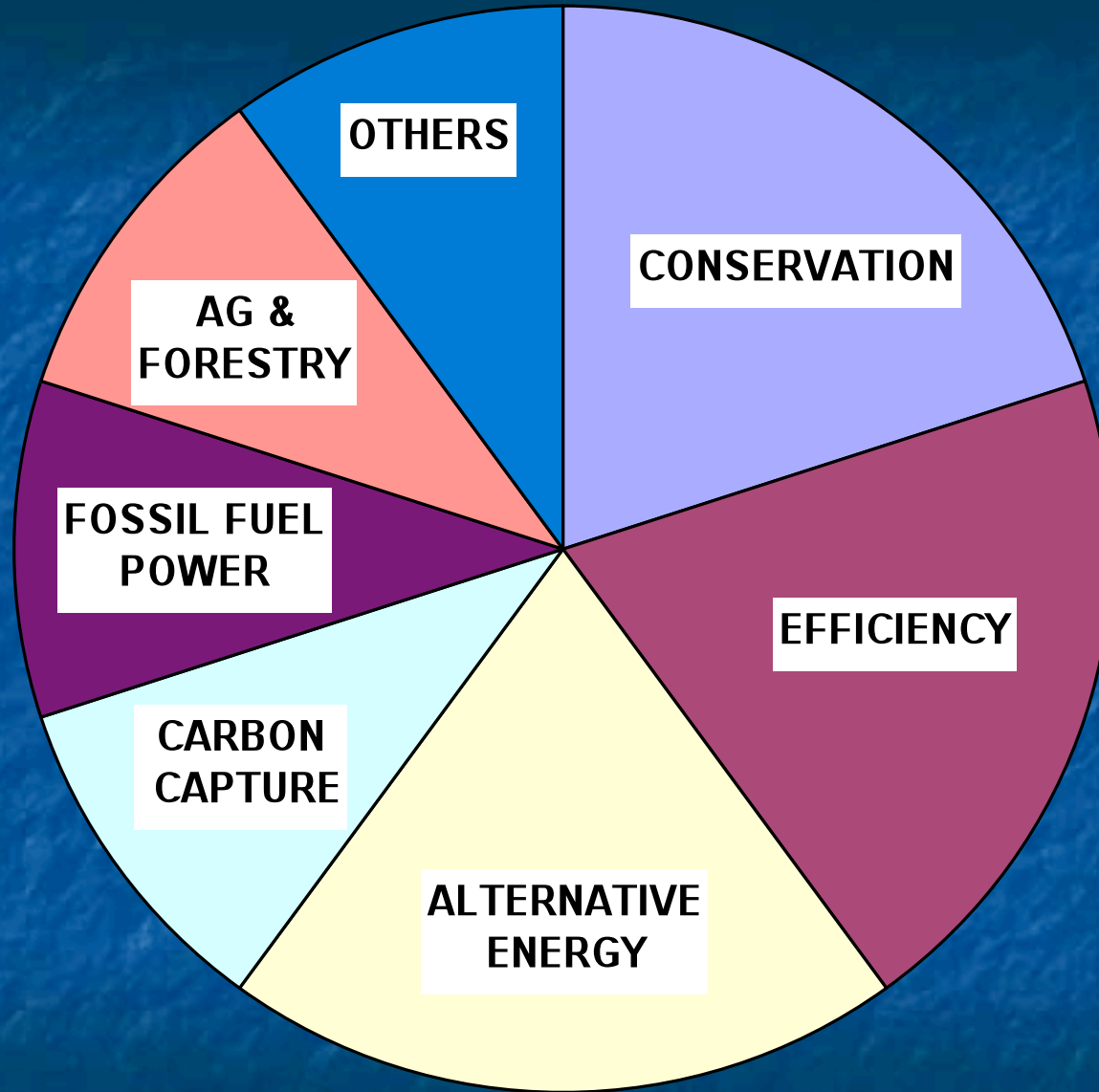
- ▶ **Cleaning up Coal**
- ▶ **The Nuclear Option**
- ▶ **Hopes for Hydrogen**
- ▶ **Biofuels and Renewables**
- ▶ **Fusion and Other Dreams**

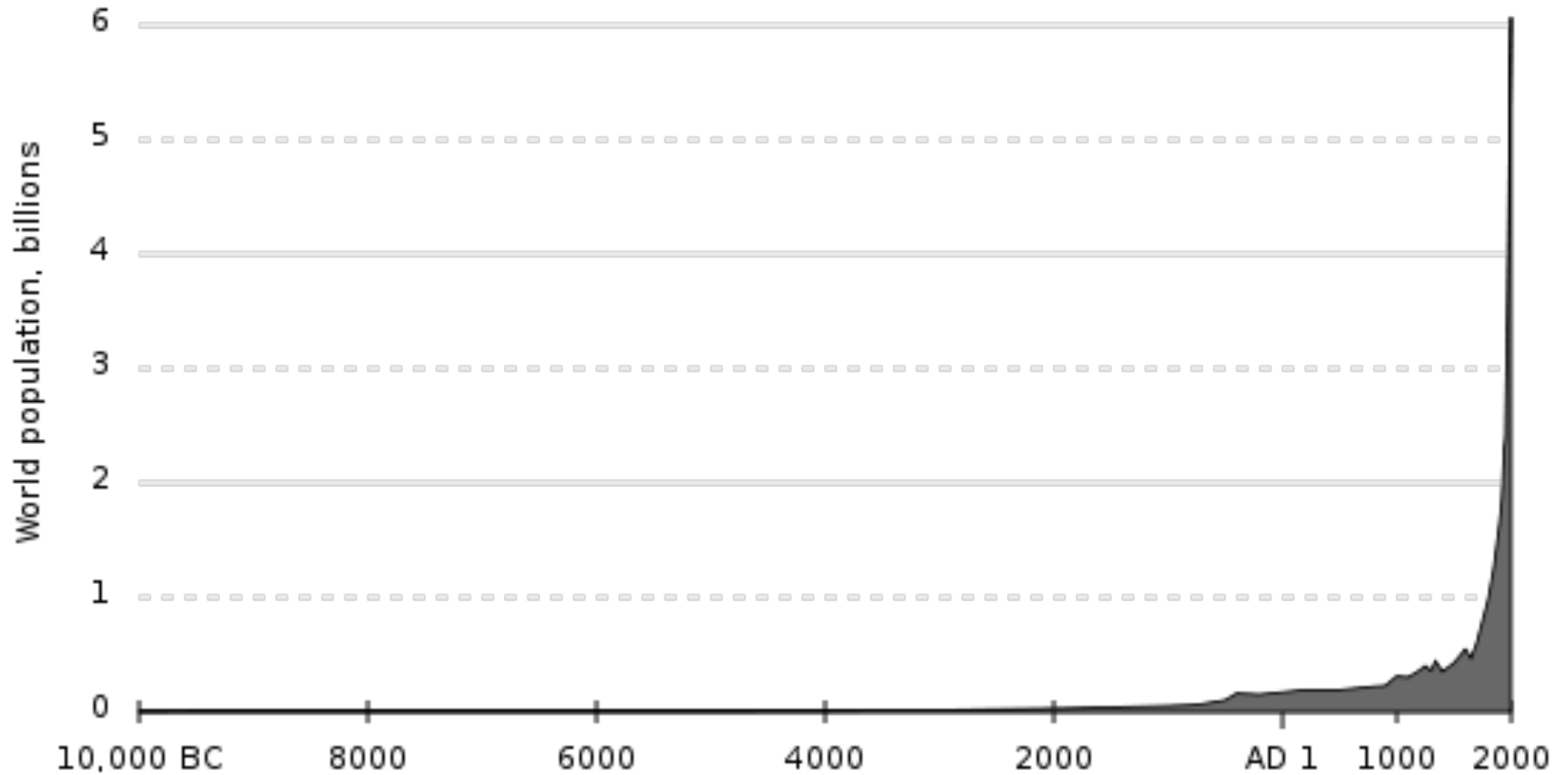
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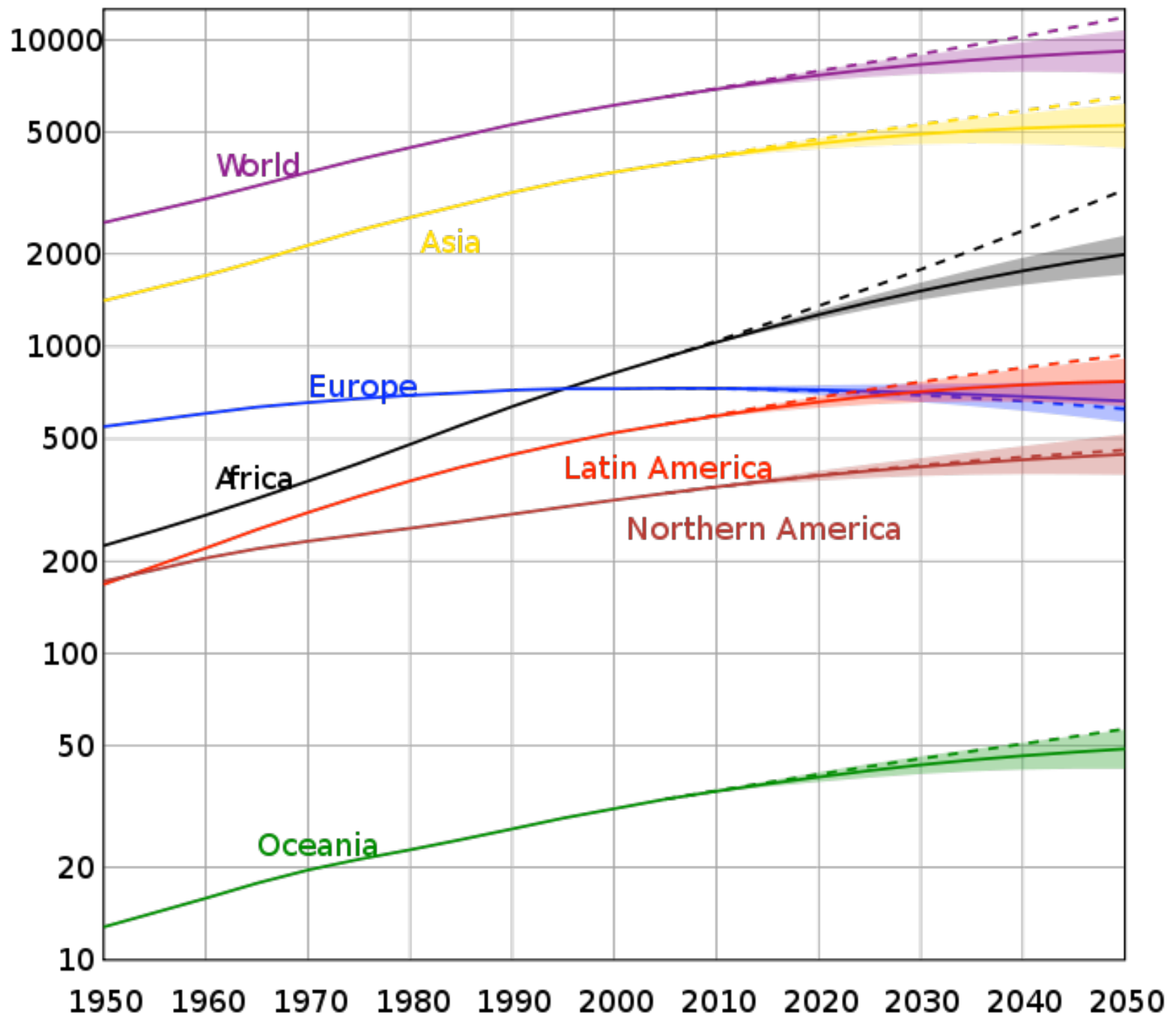


Estimated world population from antiquity to present.

source: Wikipedia, world population

But wait a minute

- I've heard that European, Russian, and Japanese populations are shrinking.
- Surely this is problem in the developing world and not a U.S. problem.



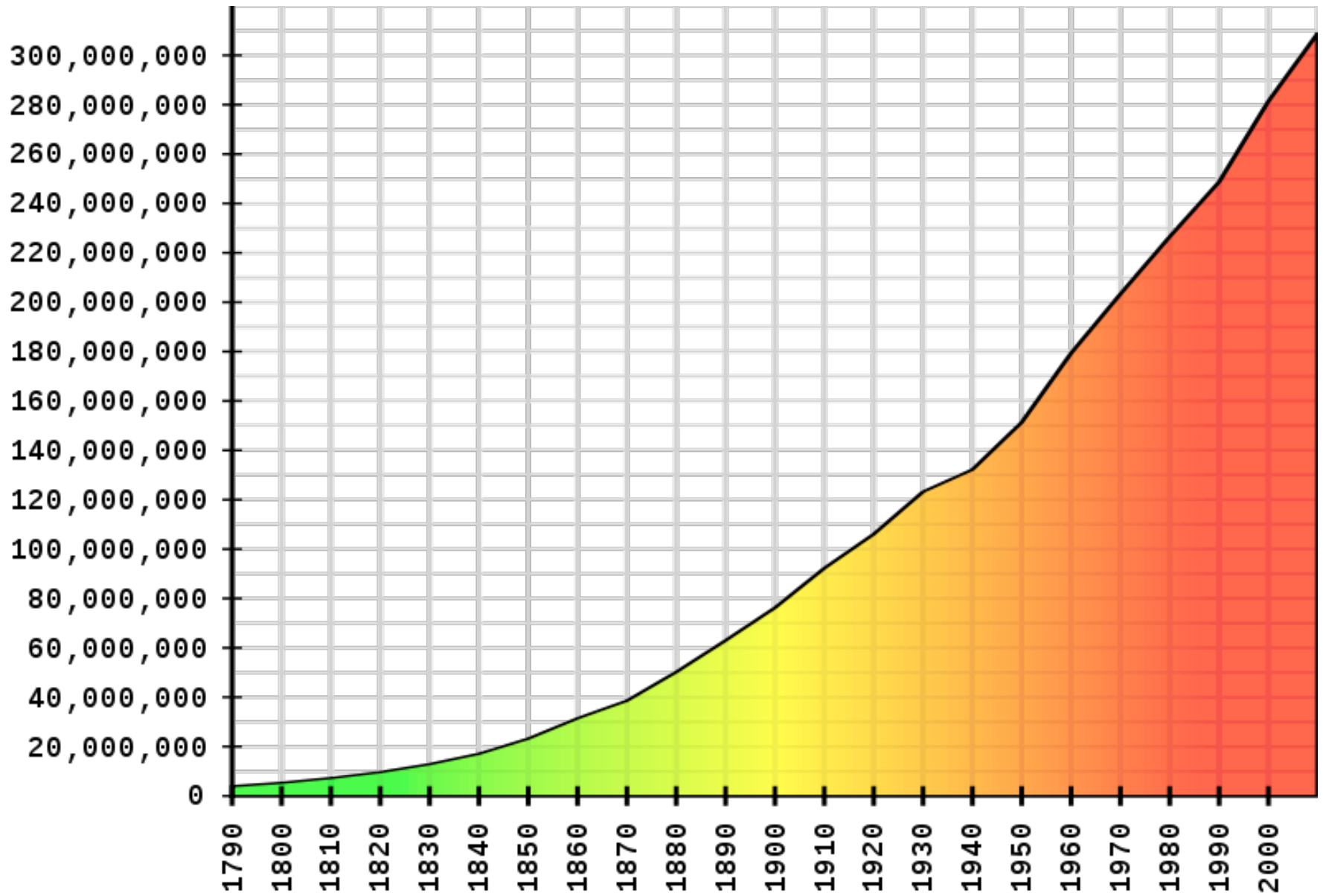
History of Human Population

<u>Year</u>	<u>Delta Years</u>	<u>Est. Humans in billions</u>
1800		1
1930	130	2
1960	30	3
1975	15	4
1987	12	5
1999 (October)	12	6 (U.N. recognized)
2009 (current)		6.7
2012*	13	7
2025*	13	8
2050* 2008)	21	9.2 (United Nations
2100*		???

Sources: U.S. Census Bureau, United Nations 2008, and Population Connection

Where is world population going?

- 1963 world growth rate peaked at 2.19%/year
- 2000 U.N. estimated 1.14%/year
- 1.14%/yr for 100 years = a tripling of population!!
- U.N. 2008 median estimate is ~ 9.2 billion by 2050
- Estimates generally range from 9 to 11 billion in 2050
- Steady-state is not in sight.



U.S. population growth based U.S. Census Bureau data.

U.S. Population Statistics

- 1990 Census 249 million
- 2000 Census 281 million
- 2009 est. 309 million
- $\Delta = 60$ million in 19 years
- 3x the population of Australia
- 1.3%/yr growth rate in 20th century
- 1.3%/yr for 100 years = 1 billion in 2100

Population growth ≠ sustainable

- 1 million people = 1,000 megawatts (MW)
- 60 million people = 60,000 MW

- 1990 10,000 MW of installed wind turbines
- 2000 10,000 MW
- 2009 25,000 MW

The entire U.S. wind turbine industry added about 25% of that needed by increased population.

Impediments to Steady-State

- Economic growth.
 - Wall Street thrives on growth
 - New housings starts
 - Growth of the GDP
- Individual rights are paramount in our society
 - “The needs of the many outweigh the needs of the few.” Mr. Spock
- Lobbyists for growth
- Our culture does not like limits
- Medicare and Social Security
- The tax system favors population growth
 - more children = more deductions
 - more people = more revenue
 - more consumption = more revenue
 - CLA Planning – “we will do nothing to impede growth”
- Religious attitudes

“Most peoples, for deep-rooted and widely diverse reasons, consider population control highly sensitive. Hence broad-based dialogue is avoided. This taboo must be uprooted.”

Mark D. Hollis, PE, BCEE
Assistant Surgeon General
Rear Admiral USPHS
Environmental Engineer

Can Engineers Come to the Rescue Again?

- There is hope, but time is not an ally.
- Doom and gloom is not sustainable.
- U.S. is again contributing to the U.N. Population Fund.
- Those stinky thermo laws are unforgiving.
- “Population stabilization is the heart of sustainability.”
R. Tim Haug, WE&T, 2007
- “Sustainable (population) growth” is an oxymoron.
- All our problems will be simpler to solve if the U.S. and world populations are stabilized.
- We have to discuss this “uncomfortable problem.”